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Commentary

Medical Manipulation of the Immune System

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ABOUT THE STUDY

A network of biological processes called the immune system guards an organism against disease. It can distinguish between the organism's own healthy tissue and a wide range of pathogens, such as viruses, parasitic worms, cancer cells, and foreign things like wood splinters. There are two main immune system subsystems seen in many species. The innate immune system responds to a variety of events and stimuli in a predetermined way. The adaptive immune system learns to recognise chemicals it has previously met and responds to each stimulus in a way that is specific to that stimulus. Both rely on molecules and cells to carry out their respective tasks.

Manipulation in medicine

The immune system can be controlled to reduce undesirable reactions brought on by autoimmunity, allergies, and transplant rejection as well as to activate protective responses against pathogens that the immune system mostly fails to recognise or cancer.

Immunosuppression: Drugs that inhibit the immune system are used to treat autoimmune diseases, reduce inflammation when severe tissue damage occurs, avoid organ transplant rejection, and manage autoimmune disorders. Anti-inflammatory medications are frequently employed to manage the consequences of inflammation. The most potent of these medications, glucocorticoids, can have a variety of negative side effects, including central adiposity, hyperglycemia, and osteoporosis. Their use is strictly regulated. Low dosages of cytotoxic or immunosuppressive medications like methotrexate or azathioprine are frequently used with low doses of NSAIDs. Activated T cells and other dividing cells are killed by cytotoxic medicines, which suppress the immune response. Other continuously dividing cells and their organs are also harmed by this indiscriminate killing, which has harmful side consequences. Immunosuppressive medications like cyclosporin stop signal transduction pathways, which prevent T cells from reacting to signals appropriately.

Immunostimulation: A kind of cancer treatment that doesn't directly target cancer cells but instead boosts the immune system in general. It might also aid the body's defences against sickness and infection. BCG, interferon alpha, and particular interleukin subtypes are examples of substances used to stimulate the immune system in general.

Vaccination: By activating B and T cells, infection leads to the acquisition of long-term active memory. Through vaccination, active immunity can also be produced artificially. The idea behind vaccination is to expose a person to an antigen from a pathogen in order to boost their immune system and create a specific immunity against that particular pathogen without actually exposing them to the disease caused by that organism. This intentional induction of an immune response works because it takes use of the immune system's inherent specificity and inducibility. Vaccination represents the most efficient immune system manipulation that humankind has created, with infectious disease still ranking among the major causes of death in the population. Numerous vaccinations are based on the acellular parts of microorganisms, including those that are innocuous toxins. Most bacterial vaccinations contain extra adjuvants that stimulate the innate immune system's antigen-presenting cells and increase immunogenicity because many antigens produced from acellular vaccines do not substantially elicit an adaptive response.

Tumor immunology: Detecting and getting rid of malignancies is another crucial function of the immune system. Immune surveillance is what we term this. Antigens that are not present on normal cells are expressed by the tumors altered cells. These antigens are unfamiliar to the immune system, therefore when they are present, immune cells attack the tumour cells that have undergone transformation. The antigens that tumours express come from a variety of sources. Some are derived from oncogenic viruses like the human papillomavirus, which causes cancer of the cervix, vulva, vagina, penis, anus, mouth, and throat. Other sources include the organism's own proteins, which are present in low concentrations in normal cells but are highly concentrated in tumour cells. One illustration is the tyrosinase

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enzyme, which, when produced at high levels, changes certain skin cells into tumours known as melanomas. Proteins that are typically crucial for controlling cell growth and survival and frequently change into cancer-causing substances known as oncogenes are a third potential source of tumour antigens.

Predicting immunogenicity: Some medications, especially those given often or in higher quantities, might trigger a neutralising immunological response, which means that the immune system generates antibodies that block the effects of the medication. This reduces the potency of medications based on bigger peptides and proteins. When a medication is not immunogenic on its own, it may nonetheless be provided in conjunction with an immunogenic substance, as is occasionally the case with Taxol. In order to predict the immunogenicity of peptides and proteins, computational methods have been developed These methods are especially helpful when designing therapeutic antibodies, determining the likely virulence of mutations in viral coat particles, and validating proposed peptide-based drug therapies. Early methods mainly relied on the finding that hydrophilic amino acids predominate over hydrophobic amino acids in epitope regions; more recent methods, however, rely on machine learning techniques using databases of already-known epitopes, typically on well-researched virus proteins, as a training set.

The cataloguing of pathogen epitopes recognised by B lymphocytes has been done in a publicly available database. Immunoinformatics is the name given to the developing discipline of immunogenicity studies based on bioinformatics. The study of big protein datasets implicated in the immune response is known as immunoproteomics.